

### REMARKS

Claims 1-16 are now pending in the application. The purpose of this Preliminary Amendment is to amend the specification and claims, and to place the application in a more traditional U.S. format. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: October 7, 2004

By: 

Philip E. Rettig, Reg. No. 34,000

Jason A. Heist, Reg. No. 51,797

HARNESS, DICKEY & PIERCE, P.L.C.  
P.O. Box 828  
Bloomfield Hills, Michigan 48303  
(248) 641-1600

PER/JAH

## RECIPROCATING ELEMENT PISTON

### DESCRIPTION

#### ~~Technical Field~~ FIELD OF THE INVENTION

[0001] The present invention relates to a piston made of a dimensionally stable material and a piston that is externally, ~~on its outer periphery,~~ enclosed by a sealing ring.

#### ~~PRIOR ART~~ BACKGROUND OF THE INVENTION

[0002] Such ~~p~~Pistons are generally known, for example, from DE 195 13 727 A1. In DE 195 12 727 A1, ~~T~~the piston can be moved back and forth parallel to its axis in a cylindrical housing, it contains a carrier part made of a hard material, and it contains a guide ring ~~that~~which externally, at least ~~partly~~partially, encloses the carrier part, ~~said~~The guide ring ~~consists~~ing of a polymeric material and ~~is~~being provided with sealing lips which, under an initial elastic tension, touch ~~an~~the inner wall of ~~a~~the housing ~~that~~facing the piston. The carrier part and the guide ring are interlinked when pressed or locked together, and the carrier part ~~is~~being provided with at least one open groove ~~that~~extends radially on the peripheral side ~~radially~~ in the direction of the guide ring, ~~said~~The groove ~~is~~being interlinked with at least one fabricated projection ~~that~~protrudes radially in the direction of the carrier part. The guide ring has ~~axially,~~ on both sides of the guide ring axially, fabricated one-piece sealing lips ~~that~~extending in a radial direction over ~~a~~the contact surface of the carrier part. The pressing force, however, with which the sealing lips touch the surface of the housing

where the sealing is to occur is relatively high, even when the pressure in the space to be sealed off is relatively low.

#### PRESENTATION SUMMARY OF THE INVENTION

[0003] ~~The~~An object of the of the invention is to ~~provide~~further develop the a piston of the ~~aforesaid~~ kind in a manner such that the wherein a friction of the piston within the housing, particularly when a low pressures is~~are~~ to be contained, is reduced. Moreover, it is an object of the present invention to provide~~was to be possible to fabricate the~~ a piston that is fabricated in a simple and economic fashion and to confer to it that maintains good use properties over a long service life.

[0004] ~~According to the invention, this objective is reached through the features of Claim 1. Advantageous embodiments of the invention are covered by the subclaims.~~

[0005] To reach thesaid above objectives, a piston made of a dimensionally stable material is surrounded, on its outer periphery, with a sealing ring that is made of an outward inflatable, elastically yielding material. By means of the inflatable sealing ring, the pressing force with which the sealing ring touches the surface of the piston-surrounding housing ~~for sealing purposes~~ is adapted to the conditions of athe desired application, ~~in question~~ and is varied to render athe pressing force that is proportional to athe pressure that is to be contained.

[0006] More particularly, Aat very low pressure, the sealing ring is ~~not at all,~~ or is only very slightly, inflated or not inflated at all, and the surface of the piston-

surrounding housing is touched ~~for sealing purposes~~ with only a very low pressing force. As a result of ~~this~~ low pressing force exerted by the sealing lip against the sealing surface of the housing, the piston can be ~~is very sensitively~~ moved back and forth in the housing very sensitively. Moreover, This slight pressing force reliably prevents stick-slip effects.

[0007] For example, if the sealing pressure within the housing increases, the sealing ring is inflated further, and thus the sealing ring touches ~~ing~~ the housing surface with an increased pressing force ~~the housing surface at a point in~~ which the sealing is to occur.

[0008] Further, The friction between the inflatable sealing ring and the sealing surface of the housing can be made ~~is also~~ proportional to the pressure to be contained.

[0009] The sealing ring is preferably made from a polymeric material and more preferably, from a PTFE compound [PTFE—=~~polytetrafluoroethylene—~~  
~~Translator~~]. In this manner, The friction between the sealing ring and the sealing surface can be ~~thus~~ further reduced. Moreover, such a piston will consistently ~~constantly~~ exhibits good ~~use~~ properties during its very long service life, because the sealing ring, after ~~an negligible~~ initially negligible wear, vitrifies. The piston, therefore, thus becoming ~~is~~ highly resistant.

[0010] The piston ~~can be~~ is preferably provided with a jacket in the form of a hollow cylinder which, for purposes of inflating the sealing ring, is provided with at least one recess that connects ~~ing~~ a pressurizable working space with an ~~the~~ internal peripheral surface of the sealing ring. The thus prevailing ~~prevailing~~ pressure in the

working space also acts on the internal peripheral surface of the sealing ring. For example, if the pressure in the working space increases, ~~the~~ increased pressure ~~also~~ acts on the inner surface of the sealing ring by inflating it radially outward in a the direction of the sealing surface. As such, ~~The~~ sealing ring automatically seals ~~automatically~~ by pressing against the sealing surface with a variable force.

[0011] On the other hand, if the pressure within the working space is reduced, the pressure applied to the internal peripheral surface of the sealing ring is also reduced, ~~and~~ As such, ~~the~~ comparatively lower pressure is contained by a comparatively lower force that ~~presses~~ the sealing ring against the sealing surface.

[0012] The working space is limited by a housing that surrounds the piston on its outer peripheral side. The piston can be used, for example, as a shock absorber in automotive vehicles.

[0013] The inflatable region can be created, for example, by a convex bulge of the sealing ring that is ~~directed radially outward~~ radially when viewed along a the longitudinal section of the piston, or by providing the sealing ring with at least one outwardly springy sealing lip in its inflatable region. ~~with at least one outwardly springy sealing lip~~ In this manner, the sealing ring becomes capable of touching the sealing surface of the housing ~~so as to bring about the sealing~~.

[0014] ~~The~~ An advantage of the convex outward bulging region is that ~~the~~ such a piston will exhibits particularly good sealing properties when it is disposed slightly eccentrically, relative to the housing. Moreover, such a piston can be produced in a simple and economic fashion.

[0015] On the other hand, if the sealing ring is provided with a sealing lip that can elastically expand outward, it is ~~advantageous that, even at low pressures within the working space, a sealing effect against the housing is activated within the working space, even at low pressures.~~

[0016] In this case, the sealing lip ~~has~~~~can have the form of a hinged film,~~ and is created by making a cut into the sealing lip material, without removing any material.

[0017] The automatic inflation of the sealing ring occurs exclusively as a function of pressure in the working space. ~~As such, the~~Said ring does not require separate activation devices.

[0018] The medium for inflating the sealing ring can be hydraulic or pneumatic, depending on which medium is ~~desired~~~~present~~ within the working space. ~~Further, the~~ inflatable region can be frontally ~~located frontally~~ on one side of the sealing ring ~~which~~. Such an arrangement is advantageous for many applications.

[0019] In the case that only the inflatable region of the sealing ring ~~is~~~~can~~ pressed against the sealing surface of the housing, it is advantageous that, as a result of this spatially limited orientation~~range~~, the friction between the sealing ring and the sealing surface of the housing ~~be~~is reduced to a minimum.

[0020] ~~In~~For another application, particularly when the piston ~~is~~~~can be~~ moved back and forth in ~~an~~~~the~~ axial direction, and when it is intended to seal in both directions ~~and is used, for example, in a shock absorber of a motor vehicle,~~ it is advantageous ~~that~~if the inflatable region ~~be~~is frontally ~~located frontally~~ on one side of the sealing ring, with a sealing lip being frontally ~~provided frontally~~ on the other side.

An example of such an application is when the piston is used as a shock absorber in a motor vehicle. In such a case, a sealing effect in one direction is then brought about accomplished by the inflatable region. Moreover, and a sealing effect is accomplished in the other direction by the sealing lip. As stated above, This arrangement can be particularly advantageous for use as a shock absorbers of motor vehicles, because a reliable sealing effect is provided even under extreme conditions. For example, when a lateral force acts on the piston and/or the said piston, because of other reasons related to fabrication and/or assembly, is disposed eccentrically within the housing. During operation of the piston, the sealing lip is then effective in only one direction.

**[0021]** Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0022]** The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

**[0023]** In the following Figures 1 and 2, two embodiments of the piston of the invention are described in greater detail. Each of these drawings is a schematic representation of a detail of the piston of the invention.

[0024] Fig. 1 shows a first embodiment according to a principle of the present invention wherein, when pressure is applied, the sealing ring inflates radially in the direction of the sealing surface; and

[0025] Fig. 2 shows a second embodiment according to a principle of the present invention wherein the sealing ring encloses a sealing lip capable of elastically expanding in the direction of the sealing surface.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

~~[0026]~~ [0027] Figs. 1 and 2 show a piston according to the principles of the present invention similar to that of DE 196 13 727 A1. As shown in Fig. 1, a  
sealing ring 1 of the piston of the invention is~~can, as here depicted, be~~ provided with  
an inflatable region 7 located frontally on one side, and with A sealing lip 10 is located  
frontally on the other side. The sealing ring 1 is designed as a bandage that  
encloses~~ing~~ the piston, and has an axial extension that closely corresponds~~ing~~ to  
the extension of the piston. On the sides facing each other, the piston and sealing  
ring 1 have congruent profiles that accomplish~~bring about~~ a force-actuated connection  
and/or interlocking of the parts. In another variation of this embodiment, the sealing lip  
10 is absent (not shown), and only the inflatable region 7 of sealing ring 1 can touch  
a sealing surface 8 of a housing 6 to bring about a sealing effect.



~~[0027]~~~~[0028]~~ In ~~at~~ the non-pressurized state, the sealing surface 8 of the housing 6, which is shown only schematically here, is disposed ~~at~~ a small radial distance from sealing ring 1, ~~or~~ Alternatively, the sealing ring 1 may touches the housing 6 ~~with~~ only a very slight preliminary radial tension. When low pressures are prevalent~~prevail~~ within a working space 4, the contact pressure of the sealing ring 1 against the sealing surface 8 is only minor. ~~When~~~~it~~ an increaseding pressure is prevalent within working space 4, on the other hand, ~~this~~ pressure may propagates through a recess 3 disposed within a jacket 2 of the piston ~~as far as the~~ to an inner peripheral surface 5 of the sealing ring 1. ~~The pressure and~~ inflates the inflatable region 7 of the sealing ring 1 in the direction of the sealing surface 8 of the housing 6 in a manner such that the inflatable region 7 then touches the sealing surface 8 at a higher preliminary radial tension.

~~[0028]~~~~[0029]~~ When the pressure in the working space 4 is reduced, the inflation of the ~~in~~ inflatable region 7 again decreases as a result of the elasticity of the material that ~~constitutes~~ing sealing ring 1.

~~[0029]~~~~[0030]~~ In Figs. 1 and 2, the sealing ring 1 is represented by broken lines. The automatic inflation of sealing ring 1 occurs exclusively as a function of the pressure in working space 4.

~~[0030]~~~~[0031]~~ Further, Fig. 1 depicts a first embodiment of the piston of the invention wherein sealing ring 1, viewed in the longitudinal direction of the piston, has a tubular shape and is linked to the surface of the piston. Upon~~With~~ increasing the pressure in the working space 4, the inflatable region 7 inflates outward in a

convex, radial manner to thus touching the sealing surface 8 of the housing 6 in a sealing fashion.

~~[0031]~~ ~~[0032]~~ Fig. 2 shows a second embodiment of the invention that differs from the embodiment of Fig. 1 in that the inflatable region 7 is formed by a sealing lip 9 which, when the pressure within the working space 4 increases, swings ~~radially outward~~ radially in the direction of sealing surface 8 of the housing 6 to thus touching the sealing surface 8 in a sealing manner. Preferably, the ~~S~~sealing lip 9 is in the form of a hinged film.

~~[0032]~~ ~~[0033]~~ The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

## PATENT CLAIMS

### What is claimed is:

1.     Piston made of dimensionally stable material and enclosed at the outer periphery by a sealing ring (1) made of elastically yielding material and capable of being inflated radially outward.
2.     Piston according to Claim 1, characterized in that the sealing ring (1) is made of a polymeric material.
3.     Piston according to one of Claims 1 or 2, characterized in that the sealing ring (1) is made of a PTFE compound.
4.     Piston according to one of Claims 1 to 3, characterized in that said piston is provided with a jacket (2) in the form of a hollow cylinder and which for the purpose of inflating the sealing ring (1) has at least one recess (3) linking a pressurizable working space (4) with the inner peripheral surface (5) of the sealing ring (1).
5.     Piston according to Claim 4, characterized in that the working space (4) is limited by a housing (6) enclosing the piston.

6. Piston according to one of Claims 1 to 5, characterized in that in its inflatable region (7) the sealing ring (1) is provided with at least one sealing lip (9) capable of elastically expanding outward and touching the sealing surface (8) of the housing (6).

7. Piston according to one of Claims 1 to 6, characterized in that the sealing lip (9) is in the form of a hinged film.

8. Piston according to one of Claims 1 to 7, characterized in that the automatic inflation of the sealing ring (1) occurs exclusively as a function of the pressure in the working space (4).

9. Piston according to one of Claims 1 to 8, characterized in that the medium for inflating the sealing ring (1) is hydraulic or pneumatic.

10. Piston according to one of Claims 1 to 9, characterized in that the inflatable region (7) is located frontally at one side of the sealing ring (1).

11. Piston according to one of Claims 1 to 10, characterized in that only the inflatable region (7) of the sealing ring (1) touches the sealing surface (8) of the housing (6) in a sealing manner.

12. Piston according to one of Claims 1 to 10, characterized in that the inflatable region (7) is located frontally on one side of the sealing ring (1) and that frontally on the other side of the sealing ring (1), on the side facing axially away, there is provided a sealing lip (10).

ABSTRACTSUMMARY

A piston made of a dimensionally stable material and which on the outer peripheral side is surrounded by a sealing ring ~~(1)~~ that is capable of inflating outward and made of an elastically yielding material.

~~(Fig. 1).~~